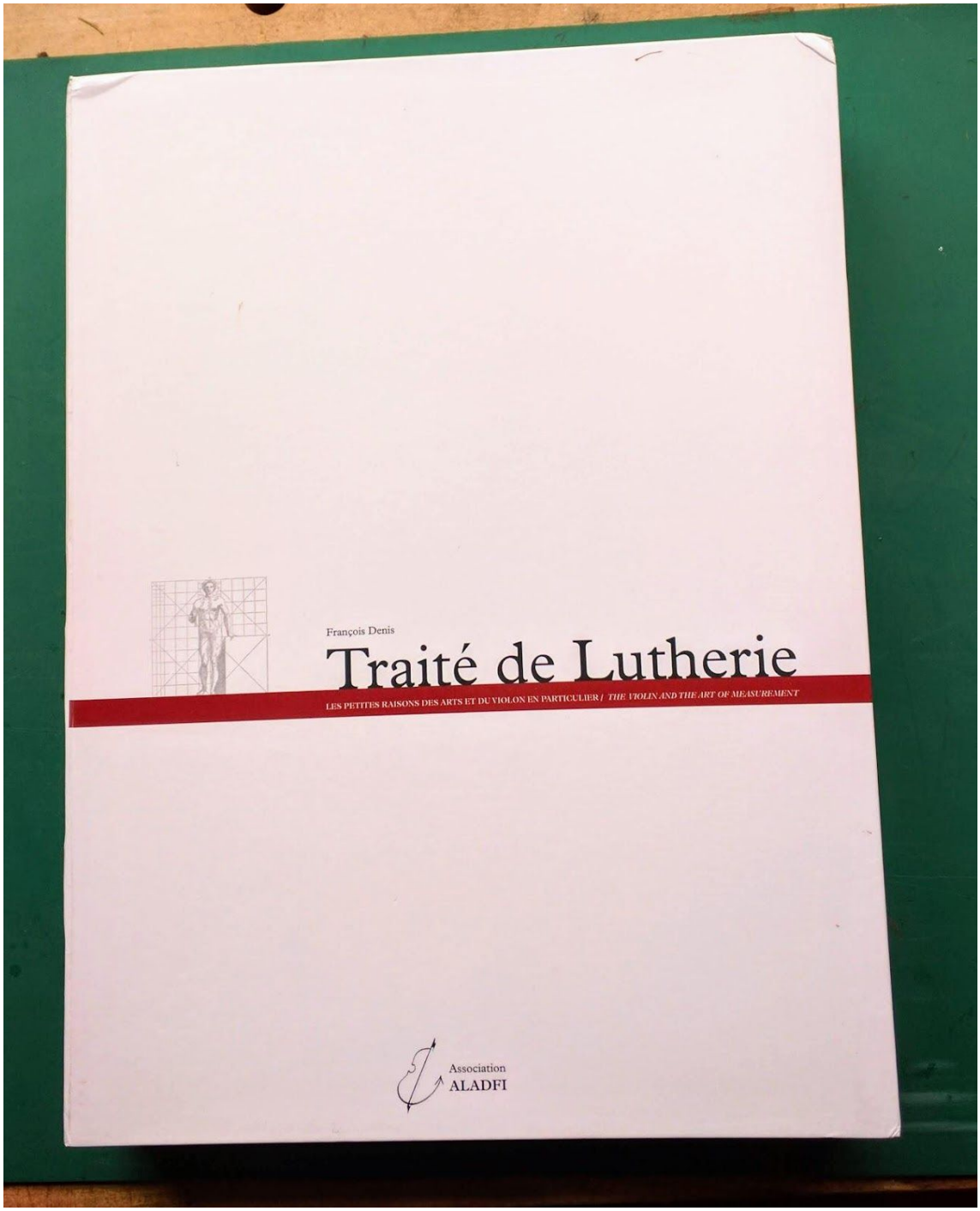
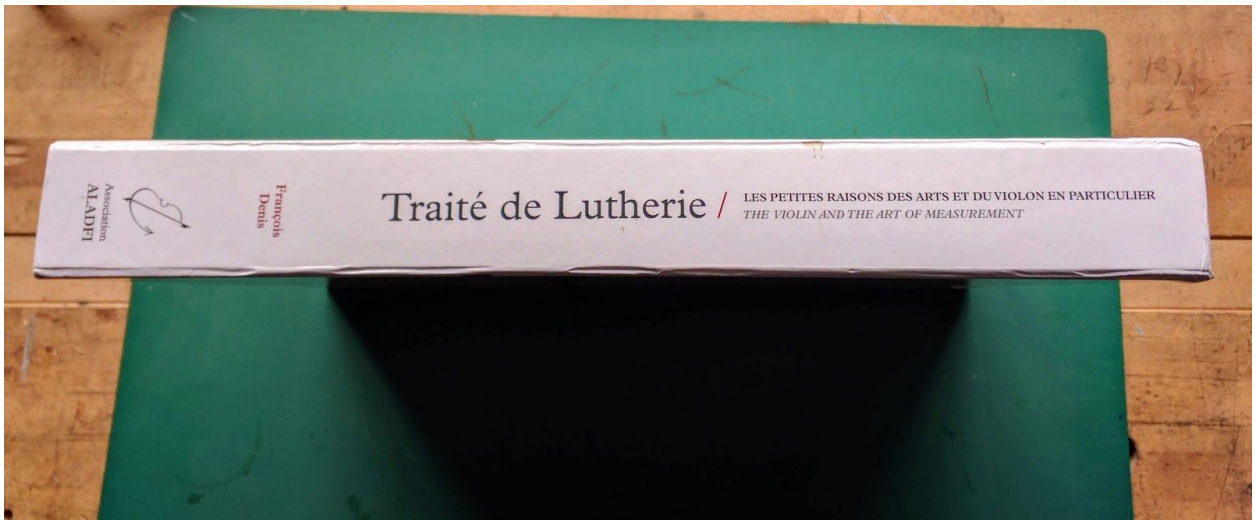
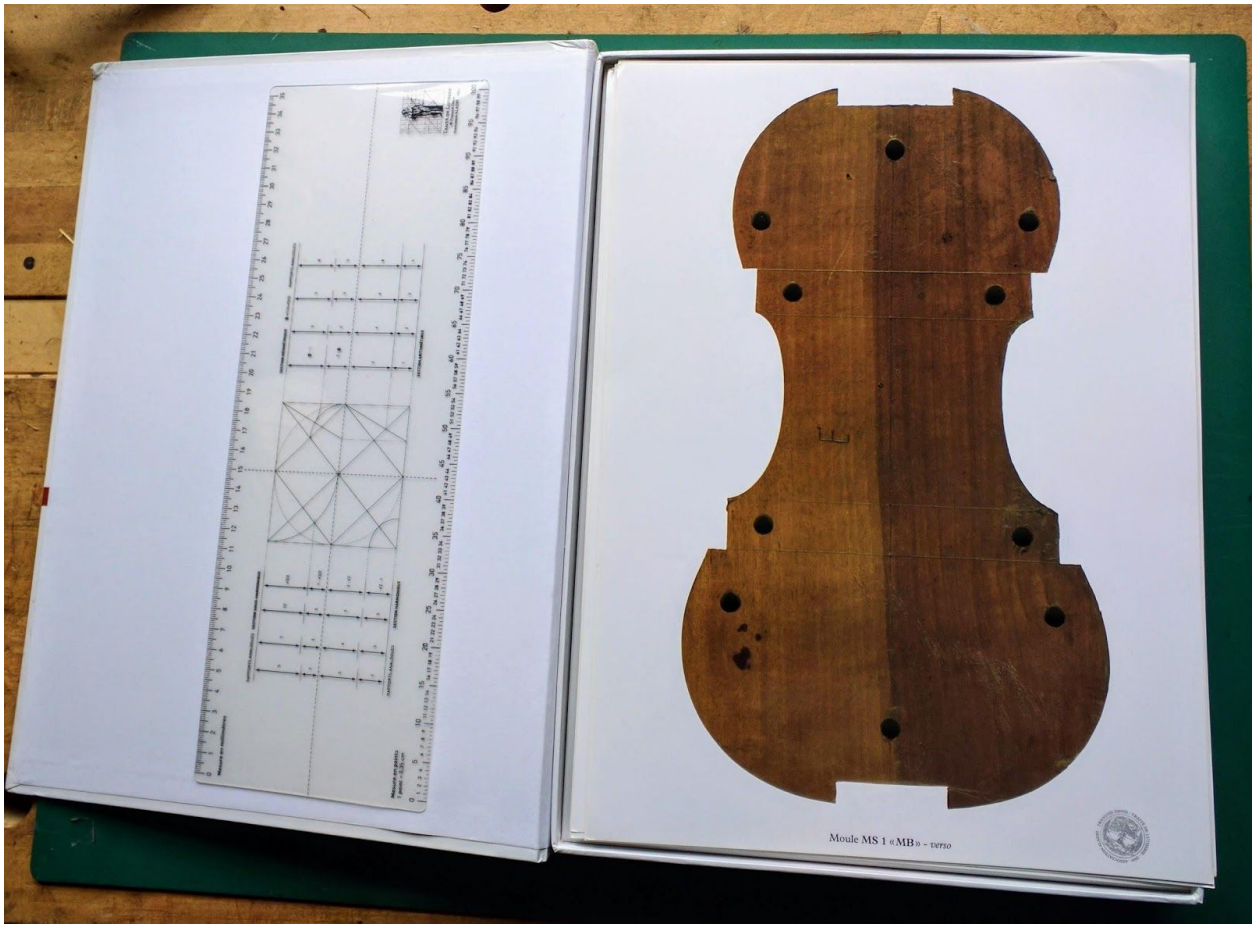
The Violin and the Art of Measurement
by Francois Denis--a boxed set:



Denis shows how traditional, pre-machine age luthiers laid out their instruments using compass and straight-edge Euclidean geometry constructions. No numerical calculations, cartesian coordinates or equational reasoning were used or needed.



Spine of box



Box set includes scale of rules and proportions as well as a set of fourteen full-size photos of the actual building jigs of master luthiers including Antonio Stradivarius.

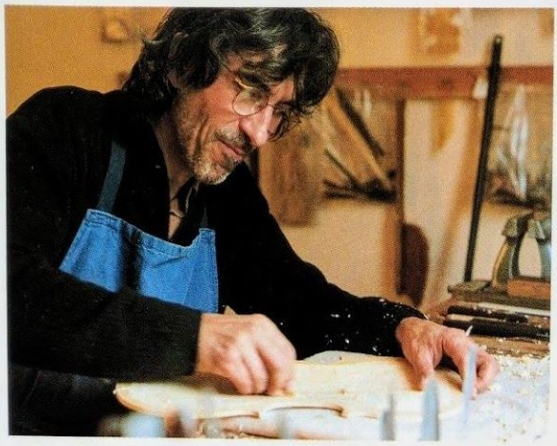
Photos are super high resolution on glossy, heavy weight paper.

Resolution is high enough so you can see original scribed layout lines and the arcs and pin prick marks left by the luthier’s compass.

The book is just over 250 pages, printed on heavy paper and smyth sewn (stitched, not glued) for an archival quality product.

Table of Contents:

The author:



The arts, according to Plotinus, do not merely *imitate the objects* we behold but must separate the form from the matter of those things and *consider the beauty in proportions*.

René HUYGHE, Dialogue with the Visible, 1955

A NATIVE OF ANGERS, FRANÇOIS DENIS studied science at university while also attending music school, but has taught himself art history and lutherie. An instrument maker since 1983, he made a wide variety of instruments before specialising in the violin family.

His multidisciplinary background led him to question the uncertain foundations of his profession. The publication of his **Traité de Lutherie** in 2006 sheds light on the history of the processes behind the violin form. The book situates the dimensions of musical instruments in the broader context of an *art of measurement*, the trace of which was lost with the approach of modernity.

In demand as a lecturer, François Denis also teaches in various schools of lutherie. He was awarded the Musicora prize in 2000 for his research.

This analysis by Denis is NOT based on the Golden Ratio because the author's professional research (not derivative internet group-think) proves that traditional luthiers (and cabinetmakers for that matter) did not use the geometric section to derive the proportions of their instruments:

3.2. THE MYTH OF THE GOLDEN NUMBER

Bearing all this in mind, we shall see how these recipes were nourished by a theoretical consideration, which can only be proportionality itself. But let us first look at a proportion that has been mystified out of all… proportion.

WHEN PEOPLE THESE DAYS TALK ABOUT A WORK or a construction having the "right" proportions, they allude to feelings of harmony, balance, rightness and beauty and, seeking to justify such aesthetic notions in mathematical terms, they often cite the geometric section, otherwise known as the "Golden Section" or "Golden Number".

Literature on the relationship between the geometric section and the beautiful emerged in the 19th century at the same time as an aesthetic movement that sought to "scientifically" prove the superiority of Western art.[4] For adherents of the movement, Greek mathematics were a proof of that superiority and the Golden Number became the touchstone which, through "science", revealed why masterpieces were beautiful.

In fact, the historical evidence to support this theory does not withstand critical analysis.[5] The true meaning of the work of the monk and mathematician Luca Pacioli has been travestied and, as the authors of a 1988 French edition of his *Divine Proportion* state: "in all humility, [we have] not had the perspicacity to find in Pacioli's writings (or for that matter in those of Vitruvius, Piero della Francesca, da Vinci or Dürer) any real application of the Divina Proportione to aesthetic ends".[6]

This historical falsification still generates interest today because it continues to provide an easy answer to the eternal question surrounding the justification of Beauty. But in fact the modern formulation of proportionality is incapable of giving a simple explanation for the diversity of past artefacts. Rather than the geometric section itself, it is our modern conception of it that is in question. As we shall see, the geometric section was used in conjunction with the arithmetic and harmonic sections (of whose existence few Golden Number specialists are aware) in a practical and theoretical context going back to very ancient knowledge and traditions that probably predate the first theoretical propositions of Greek mathematics.

Some sample pages follow:

I-4. Analysis of measurements in a 15th century technical drawing

4.1. Henri-Arnaut de Zwolle's Lute

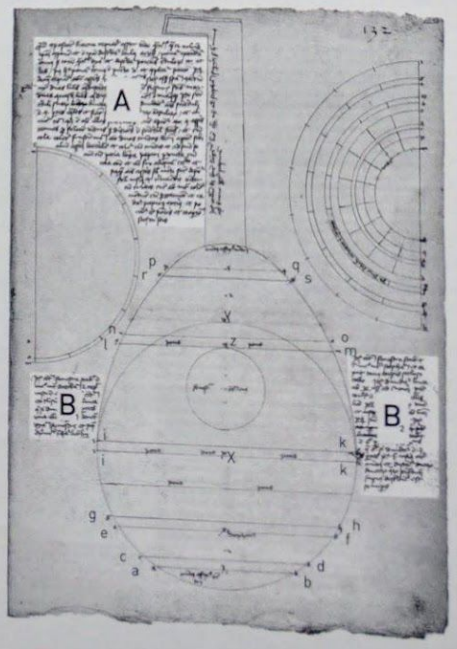
Henri-Arnaut de Zwolle was born in 1400 and died of the plague in Paris in 1461. A scholar who placed his knowledge of physics and astronomy at the service of Philip the Good, Charles VII and Louis XI, he is best known for a manuscript,[18] now in the Bibliothèque Nationale de France, containing information relevant to our subject here. The *Treatise of Henri-Arnaut de Zwolle* is in fact a compilation of anonymous writings, mostly about keyboard instruments. One page of the treatise is devoted to a "technical drawing" of a lute and contains a compass drawing and a descriptive text. It gives succinct but precise instructions for making a mould, composing the various parts and placing and sizing the bridge, the soundhole and the bars. The lute body is made of wooden slats, trimmed and glued. This elaborate technique replaced block carving in the 13th century.[19]

The document is of great interest since it combines the description of a construction process with a compass-drawn diagram, showing a front view and a cross-section. The drawings of the mould and the templates are superimposed and several lines are common to both drawings. The association of a front view and a cross-section was still a novelty at the time;[20] it became more widespread with the use of paper, a medium cheaper than parchment. We know that it is a first draft since Zwolle makes various mistakes that he takes the trouble to correct.

18. Treatises by Henri-Arnaut de Zwolle and various anonymous authors, Bibliothèque Nationale, Paris, [ms Lat. 7295].

19. Christian Rault, "Géométrie médiévale, tracés d'instruments et proportions harmoniques" in *Instruments à cordes au Moyen Age*, ed. Créaphis, Grânes, 1999, pp. 49-74.

20. The accuracy of the technique for drawing the lute body should not mislead. The surprising 3/4 view of the pegbox is a striking reminder of the conventions of Gothic figuration.



The text at top left (A) describes the method for constructing the body. The text on either side of the lute (B1 et B2) gives the relations of the various organic elements in ratio form (same and part). The length of the neck is given relative to the maximum width (ratio of the same) and the upper block is equal to one part (defined in text A). The bridge is situated at 1/6 of the length, the centre of the soundhole is at the midpoint of the space between the bridge and the top of the body and the lower block is said to measure the third of the space between the bridge and the bottom of the instrument.

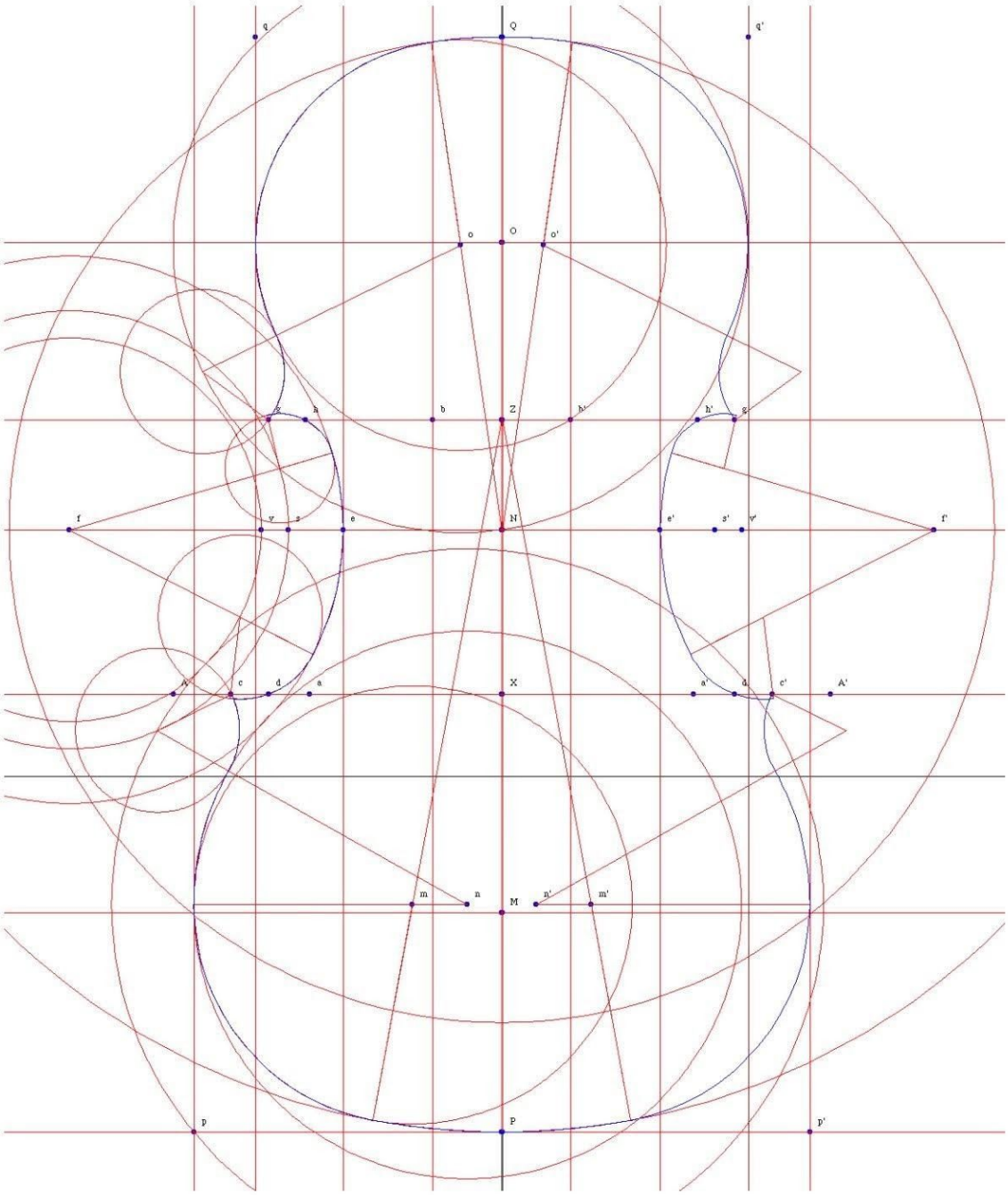
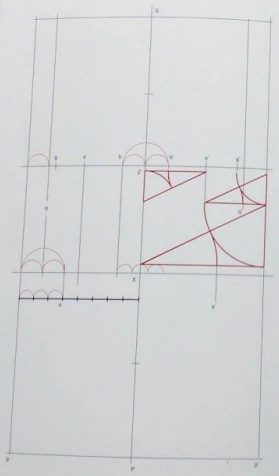


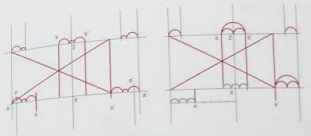
Figure 6. *Violin by Andrea Amati*

3. See 'Andrea Amati violin outline: analysis and commentary', p. 138.

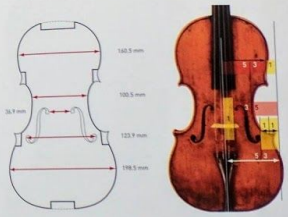
The arcs are drawn according to principles already described elsewhere. The values of the arc radii are derived from the various elements of the framework. A symmetrical division of the segment XZ is used in the C-bout.[3]
These drawing techniques, based on successive divisions, demonstrate acute sensitivity to form. Enhanced by time and experience, the knowledge and skill embodied in them were passed on from father to son.

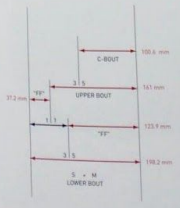


▸ *Symmetrical construction of the horizontal dimensions by the right-angle triangle of the double square (right) and its equivalent in arithmetic measures (left).*



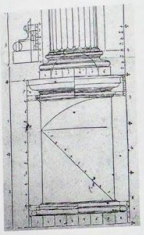
▸ *Kinship of symmetrical constructions: placing of the interior limit of the f-holes by Andrea Amati (left) and his sons (right).*





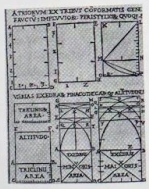
▸ *Horizontal proportions.*

Craftsmen had a thorough knowledge of the equivalences between proportional compass drawings and their whole-number measurements. This age-old craft lore, bearing the stamp of the Pythagoreans, is apparent in the design of musical instruments. Reconciling the demands of artistic sensitivity with those of craftsmanship, it survived for a long time on the margin of scientific upheavals. The examples given in the following chapter will show how such systems can be deduced from an instrument's principle measurements.



10. Hans Blum, *Von den fünff Sülen*, Zurich, 1550.

▸ *Drawing of a rectangular base where each side corresponds to a term of the harmonic section. Only the beginning of the construction is drawn with a compass.*[11]



11. *Di Lucio Vitruvio Pollione de Architectura*, Cesariano, Como, 1521.

▸ *Any construction begins with the definition of a surface. This illustration from Cesariano's book on Vitruvius*[12] *shows how the use of a compass is related to the divisions of the square.*

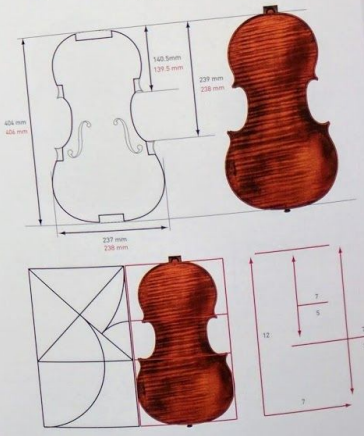
3.4. Some examples of frameworks

Knowing the underlying structural principles, it is possible to precisely reconstruct the chain of relations that determine an instrument's measurements. The processes used to determine their main dimensions were applied systematically, as may be seen from several examples of instruments made in Italy in the 16th and 17th century.

In all the illustrations showing the vertical division:
- the analysed measurements are shown in black on a mould form[1] and the theoretical measurements are shown in red;
- the diagram at lower left shows the geometric construction associated with the division;
- the diagram at lower right shows the section ratios used to calculate the theoretical measurements. For example, a notation 1/(2√2) corresponds to the irrational ratio of a compass construction while a whole-number ratio like 12/5 corresponds to an approximation of such a construction.[2]

In all the illustrations showing horizontal symmetries:[3]
- five main dimensions have been chosen for each of the examples below;
- the analysed measurements are shown in black on a mould form and the theoretical measurements are shown in red;
- the tree structure of relations and the theoretical measurements (in red) are also shown at lower left;
- in the diagram at upper right, different colours are used to show the organisation of these sections directly on the instrument.

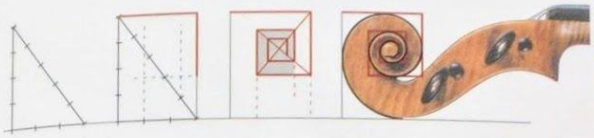
Stauffer viola, Antonio and Girolamo Amati, 1615
Vertical division



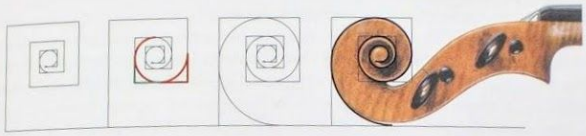
1. The edge and rib values have been d… when calculating these measurem…

2. The ratios measure a section of th… between the two points of an arro… means that the space has been di… parts with 7 parts on one side and… other.

3. The divisions indicating the lengt… tips are not included.

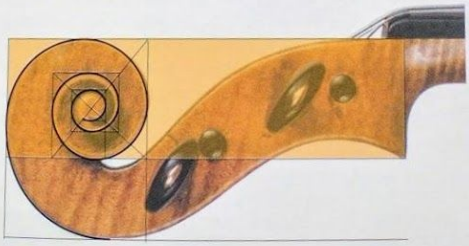


▸ *The 3, 4, 5 triangle gives the measurements of the frame for the volute and the first turns. A rectangular spiral in a 2/3 ratio cleverly completes the construction.*



▸ *The turns are drawn from the sides of the rectangular spiral. The radii are deduced from one another, starting with the first. The centre of an arc is found from the tangency points.*

All the Amati family volutes use this system and the consistency between the theoretical outline and the sculpted volute can be surprisingly accurate. Drawing a volute on the scale of a violin requires a great deal of application, and the limits of the framework provide sufficient information for the turns to be drawn freehand. As is often the case, the proportional scheme is more important than the method for drawing the arcs.



▸ *The height of the pegbox is equal to that of the whorl; the comma stops at the level of the cross of the rectangular spiral. Some of the reference points in the framework became attenuated as makers interpreted the form.*

The Amati family volute served as the basic model for most instrument makers, including Stradivari. Comparing a theoretical model of an Amati volute with a Stradivari volute on the same scale clearly shows the arbitrary nature of Stradivari's method.

A paper reviewing this book is available as a PDF here:
https://www.cs.brandeis.edu/~mairson/Papers/ICFP062-mairson.pdf